Institute of
Technical Physics

Design of a CBE Stand-Off Detector for Operational Use by Fire Brigades

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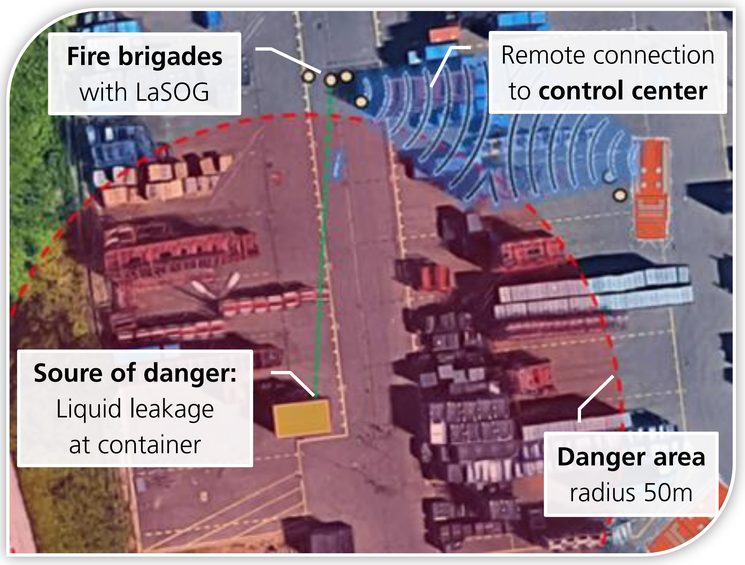
Motivation

- Effects of globalization lead to a growing number of total transports
- Transport disasters, like liquid leakage of hazardous substances from container, belong to daily life of fire brigades [1-3]
- Controlling of hazardous incidents is for the fire brigades both, time consuming and dangerous
- Released substances are often unknown

Overall concept

- Fast reconnaissance of released liquids from a safe distance (range of security zone ≈ 50 m)
- Prompt immediately for appropriate countermeasure



General requirements

- Quickest possible information on the incident and the hazard potential
- Measurable lead compounds corresponding to *vfdb*-guidelines
  - hydrocyanic acid (HCN)
  - hydrochloric acid (HCl)
  - ammonia (NH_3)
  - harmless liquids (i.e. water)
- Harmless, eye-safe system operation

① LaSOG: Laserbasiertes Stand-Off Gefahrstoffdetektionssystem

LaSOG(①) – Laser based standoff detection of hazardous liquids

- Design of a laser based detection system for operational use by fire brigades
- Real-time information about the released liquid
- High sensitivity and selectivity
- Measurement of the characteristic spectral signature of released liquid
- Classification by an integrated database algorithm

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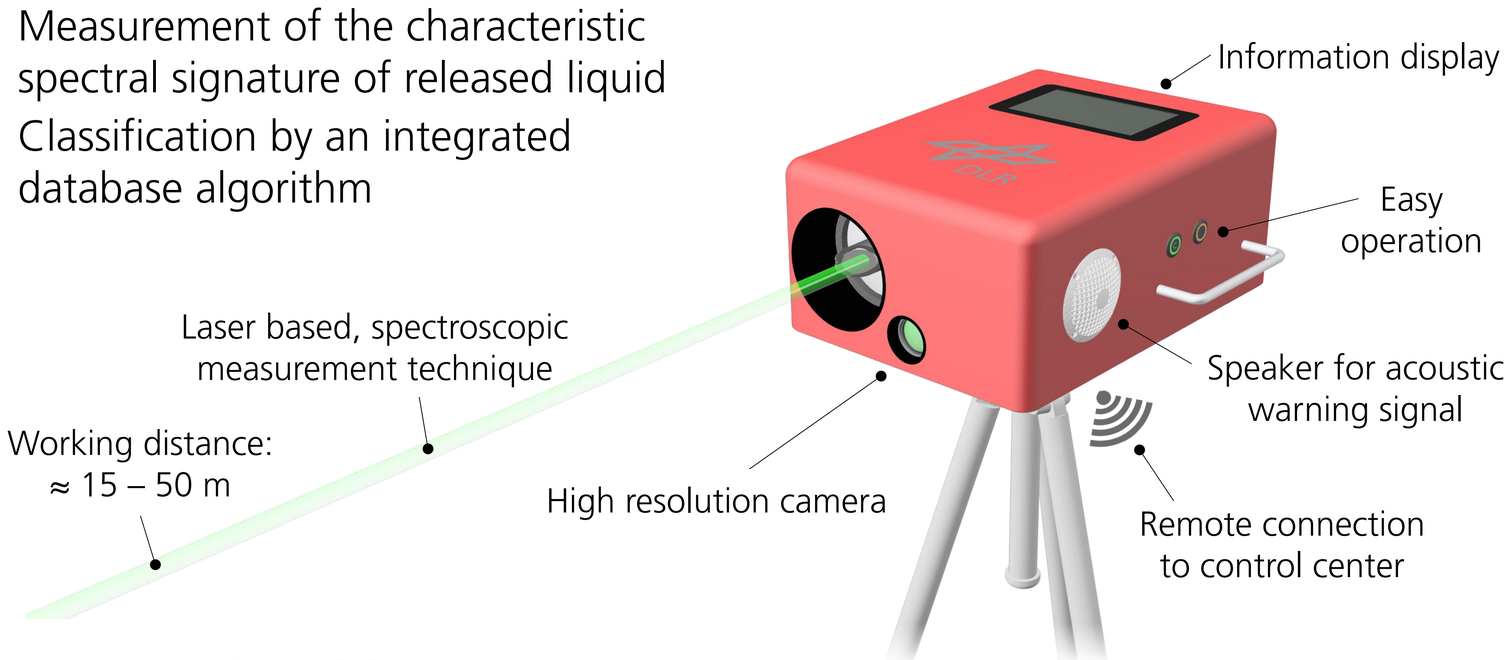
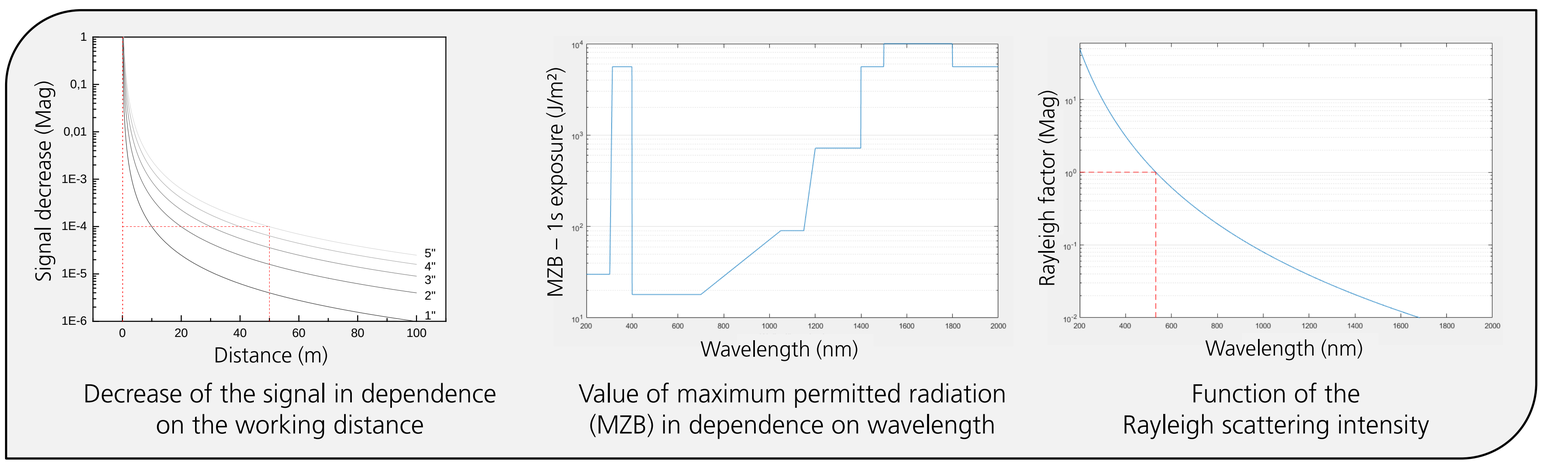


Aims & results of feasibility study

- Selection of appropriate measurement technique
- Estimation of achievable sensitivity compared to lab system

➢ **Eye-safe detection and classification of liquids at a working distance of 50m is possible!**



Decrease of the signal in dependence on the working distance

Value of maximum permitted radiation (MZB) in dependence on wavelength

Function of the Rayleigh scattering intensity

- Signal drop due to geometric factor in the order of 10^4 – 10^6 magnitudes

➢ **Innovative concept based on Raman spectroscopy**

- Compensation of geometric factor by using UV excitation and optimized detection system:
  - MZB factor: ≈ 300x
  - Rayleigh factor: ≈ 3x
  - PMT-amplification: 10^3 – 10^6

  } ≈ 10^6 – 10^9
- Minimization of laser mode divergence by means of a telescope
- Single wavelength excitation
- Eye-safe operation guaranteed
- Effective suppression of ambient light
- Low fluorescence noise

Future tasks

- Setting up LaSOG system
- Performing first tests under outdoor conditions on the DLR test range
- Optimization for fire brigade operation during field tests

[1] Südkurier; Großeinsatz in Petershausen: Zwei Verletzte bei Chemieunfall; 20.1.2018
[2] Welt.de; Bahnstrecke nach Kesselwagen-Unfall wieder frei; 3.12.2016
[3] Badische-Zeitung.de; Gefahrstoff tritt aus Kesselwagen aus; 5.1.2018

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